BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems	))))))	 PR Docket No. 93-61 RM-8013

TO: The Commission

AFFIDAVIT OF B. KEITH RAINER

STATE OF MISSOURI)
)
COUNTY OF ST. LOUIS)

B. Keith Rainer, being duly sworn, deposes and says:

A. Qualifications

I have a bachelor's degree in Electrical Engineering which I received with honors from Auburn University. I also have a M.S. in Electrical Engineering which I received from the Georgia Institute of Technology. I have completed extensive graduate studies beyond the my masters's degree.

Following the completion of my bachelor's degree program in 1980, I began employment with Bell Telephone Laboratories. While at Bell Laboratories, I worked on the development of digital switches, circuit analysis programs, system reliability analysis programs, coding for memory management, and advanced signalling protocols. During this time period, I also completed work on my masters degree.

In 1983, I left Bell Laboratories and began employment with the Georgia Institute of Technology (Georgia Tech) as a member of the research faculty where I achieved the position of Senior Research Engineer. While at Georgia Tech, I performed extensive research in the areas of applied electromagnetics and communication systems, taught continuing education courses on selected topics in electromagnetics, and was accepted into their electrical engineering doctoral program.

I am currently an employee of Southwestern Bell Technology Resources where I have been a Member of the Technical Staff since 1990. At Southwestern Bell Technology Resources, I am involved in work on radio based communications system and products. My specific areas of interest have included; indoor microcellular systems, outdoors and indoors wireless data systems, mobile location technology, antennas, electromagnetic propagation modeling and measurements, and radio communication protocols.

I have authored and co-authored numerous technical papers and reports on antennas and radio communication systems. I have received two Certificates of Recognition from NASA, an Industrial Design Achievement Award from Roger's Corporation, and the Outstanding Researcher of the Year Award from the Georgia Tech Research Institute (1989). I am a member of the Eta Kappa Nu and Tau Beta Pi engineering honor societies.

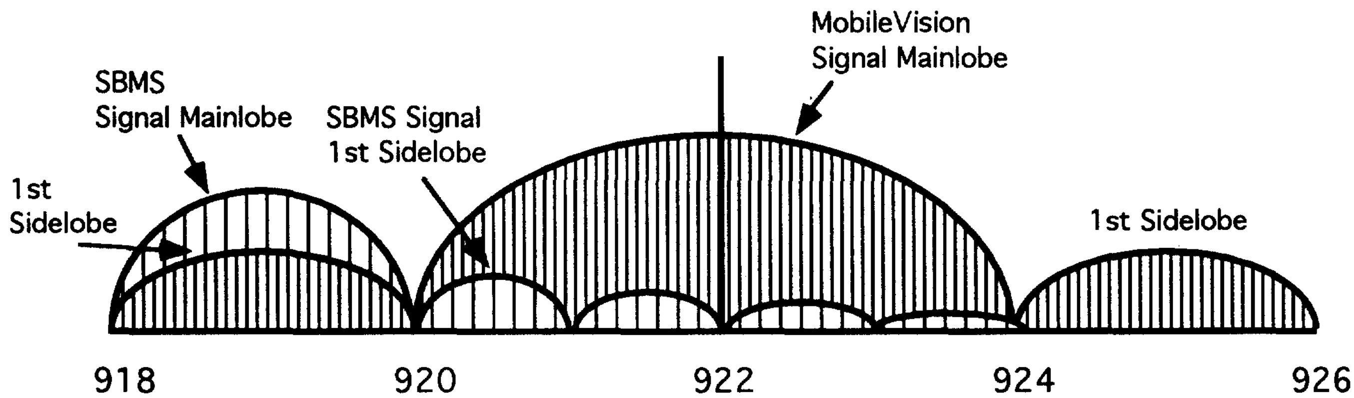
B. Statements

The following is provided in response to remarks included in Teletrac's and MobileVision's comments on NPRM 93-61 in the matter of amendment of Part 90 of the Commission's Rules to adopt regulations for Automatic Vehicle Monitoring Systems..

1. In Teletrac's and MobileVision's comments to the NPRM, they argue extensively about the need for exclusive 8 MHz spectrum allocations due to the problems of co-channel interference.[1] As stated in its comments, SBMS has an LMS technology which will operate in a shared band mode in the Chicago MSA and provide minimal interference to any potential MobileVision LMS system. However, due to the uncontrolled nature of technologies and entrants into the LMS bands, SBMS has proposed a spectrum allocation plan which will accommodate Teletrac and MobileVision while providing for additional competitive systems.

Given this position, some additional comments are in order on the subject of sharing to help put this subject in the proper perspective. First, co-channel interference is not a new problem and is successfully managed by both narrow-band and wide-band radio technologies such as cellular (AMPS) systems and wireless LANs and wireless PBX systems (in the 902-928 MHz band). Interference is managed through an appropriate selection of technologies and careful system design. The SBMS LMS system to be deployed in Chicago is an example of both. The SBMS Quiktrak LMS technology will operate reliably in the upper LMS band in the Chicago MSA with the current interference levels and the presence of a MobileVision LMS system. This can be accomplished through careful spectral placement of the SBMS Quiktrak system within the band to minimize interference with a potential MobileVision system and by deploying an LMS technology that is highly resistant to noise. In the SBMS LMS system wide band signal, about 99% of the transmitted power occurs in the main lobe and 1% in the sidelobes. The spectral placement of the SBMS system in the upper LMS band for operation in Chicago is illustrated below.

[1] See Teletrac's NPRM response volume 1, page v, page 25, and others. Also see MobileVision's NPRM response, pages 30 & 34 (among others).



Wideband Signal Spectrum Envelope
Upper LMS Band

The spectral position of the wide band signal has been selected so that less than 1/2 of 1% of the power transmitted in the wide band signal of a transponder operating on the SBMS LMS system will occur in the main lobe operating bandwidth of the wide band portion of a MobileVision LMS system.[2] The placement also positions the main lobe of the SBMS LMS wide band signal over the first sidelobe of the MobileVision LMS system wide band signal. This placement minimizes interference to both LMS systems. SBMS's operation in the upper LMS band should not be considered to be co-channel with MobileVision but co-band. The SBMS system could also function if its wide band signal main lobe was centered at 922 MHz, however, in an effort to minimize mutual interference, the placement illustrated above was chosen.

It should be pointed out that in the MobileVision comments on NPRM 93-61, they have defined the required bandwidth for their system to include the main lobe and the first sidelobes. Their main lobe is 4 MHz wide and their first sidelobe is 2 MHz wide.[3] Mobile Vision states that their system requires a full 8 MHz to operate in, however, since their wide band signal receiver will filter out all but a portion of the main lobe, the remainder (at least 4 MHz) is not being utilized. Therefore, the MobileVision system does not require 8 MHz to operate within. Standard definitions of direct sequence spread spectrum bandwidth refer either to the null-to-null bandwidth of the main lobe or the 3 dB bandwidth of the main lobe. It should be pointed out that the MobileVision LMS system would be fully accommodated by the SBMS proposed spectrum allocation plan as would Teletrac

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[2]Also note that due to the nonpersistent nature of LMS communication, the time average power of a wide band signal is extremely small. As these transmissions are generally randomly distributed over a large geographic area, the local concentration of transmitted power is also extremely low.

[3] See MobileVision's NPRM response, page 30.

2. To further expand on radio interference issues, one should point out that there are many ways to address the effects of interference (which will be referred to as noise in this discussion) in the design of a radio system and the radio system technology. There are also many ways to demonstrate the effect of noise on a system design or performance. A calculation has been provided to illustrate the effect of noise on the Quiktrak system with respect to coverage. The calculation is based on Quiktrak receiver noise bandwidth and maintaining a constant level of service (accuracy, response time) and capacity with increasing noise levels. Environmental effects for mobile radio systems, such as multipath and Doppler, are not explicitly treated in this calculation. The noise levels used in the calculation are extracted from Teletrac's NPRM 93-61 reply comments.[4] A correction has been applied in these figures for a reduction in the thermal noise contribution due to Quiktrak's 2 MHz bandwidth instead of 8 MHz bandwidth for which Teletrac's numbers were calculated. In actuality, all noise contribution would be significantly reduced from Teletrac's figures due to the reduction in receiver noise bandwidth, however, the numbers from Teletrac's example are acceptable for the illustration. It should also be pointed out that for the locating element of the LMS system. the wide band signal would need to be received at a minimum of three base station receivers.

<u>Quiktrak Wide band Signal Link Budget Example</u>:

Noise = kTB + Co-channel or Other Noise Sources

kTB = -111.8 dBmW

Additional Noise (from Teletrac) = 10 dB Therefore, Noise = -101.8 dBmW

Process Gain = 37 dB

Required S/N = 18 dB

Receiver Sensitivity = -101.8 -37 +18 = -120.8 dBmW

Assume That a Mobile has an ERP of 1 W (or 30 dBmW)

Base Station Receiver has an Antenna with 12 dB of Gain.

Need Signal of -120.8 dBmW so from a mobile to a base station system can allow 120.8 + 30 + 12 = 162.8 dB of attenuation.

(from W. C. Y. Lee's work on Mobile Communications) for a base station with an antenna height of 100 ft at 900 MHz in an urban/suburban environment:

[4] Teletrac NPRM 93-61 response Volume II, page 9.

Path Loss $P_L = 107 + 39 \log$ (distance in miles)

Distance in miles $= 10^{(P_L - 107)/39} = 27$ miles (or 45 km)

Therefore, the coverage radius of the base station is 27 miles. For 10 dB of more noise, coverage is reduced to 15 miles.

As demonstrated by this basic calculation, one way to view the results of increasing system noise power is a reduction in coverage area. This change would effect the economics of deploying an LMS system, but would not necessarily disqualify it as a reasonable business opportunity. Other factors such as market size, competition, and pricing would have to be examined to fully evaluate the opportunity. As has previously been stated in remarks to the FCC, the SBMS Quiktrak LMS technology can operate reliably in the current radio environment in the upper LMS band in the 902-928 MHz ISM spectrum in the Chicago MSA. SBMS has provided a proposal for spectrum allocation which would address concerns on the future viability of the LMS bands while providing for competition.

3. In volume 1, on page 25, of Teletrac's NPRM response, more comments are made with respect to interference and, in particular, narrow band sources of interference. SBMS is also concerned about the radio environment in the LMS bands and the potential for increase in interference. It supports the recommendation that narrow band operators be migrated out of the bands and has introduced a spectrum allocation proposal which adequately addresses concerns about the long term viability of the radio environment in these bands. However, once again Teletrac has been inaccurate in its representation of the problem. While it is true that narrow band and wide band interference both appear as noise in the spread spectrum receiver, the relative level of that noise is typically different. A narrow band signal is spread in the receiver and looks like a wide band signal and the peak amplitude is subsequently reduced. A wide band signal that is uncorrelated in the receiver is also spread and the original low level signal is even further reduced. That is, if a wide band and narrow band signal of equal total power are present in the spread spectrum receiver, the narrow band signal will introduce more noise power. This effect is illustrated below. [5]

[5] See "Spread Spectrum Systems" by Robert Dixon, 1984, page 173.

4. Teletrac expends a significant amount of its comments in its NPRM response on the economic viability of LMS systems.[6] Without providing detailed economic analysis or data (such as market size, product pricing, etc.), they develop an argument to the effect that there is no commercially viable LMS technology which can operate in less than 8 MHz of bandwidth.[7] This argument is inaccurate and their claim is unsubstantiated. It is a fact that in the state of New South Wales, Australia, a commercial LMS system is in operation which requires 2 MHz of spectrum (null-to-null bandwidth) for wide band pulse ranging signals. The LMS system, Quiktrak, is operated by British Aerospace of Australia (BAeA) and provides vehicle location and basic two-way messaging type services for fleet management and security to the New South Wales police department, the Sydney city buses, Sydney harbor ferries, trucking fleets, and others. The system has been in operation since 1989 and is commercially viable.

It is also a fact that the wide band spread spectrum signal transmitted by transponders used in Teletrac's LMS networks has a 4 MHz null-to-null bandwidth. Given this fact, Teletrac's comments with respect to the economic viability of an LMS system provided with less than 8 MHz of bandwidth are in doubt. If Teletrac has truly invested 150 million dollars in LMS technology and the deployment of LMS systems that in their own assessment are economically unviable, one should weigh very carefully any comments which Teletrac might make with respect to LMS economic issues.[8]

5. On page 23 of volume 1 of Teletrac's NPRM response, some comments are provided with respect to capacity and a "personal locator service." In the response, the commenter makes the argument that in excess of 4 MHz (one assumes that this is null-to-null bandwidth) of spectrum is required for capacity and accuracy reasons to provide this service. While locating accuracy and sufficient capacity are certainly necessary to provide this service, neither of these factors have been specified so that some reasonable discussion can be made as to how much spectrum provides sufficient accuracy or sufficient capacity. As noted elsewhere in SBMS comments, it is also true that simply increasing bandwidth does not necessarily increase locating accuracy or capacity. In fact, the opposite effect might result. The most significant issue facing the development of a "personal locator" service, which is not discussed in the comments, is how to derive elevation information. This information is necessary to determine a subscriber's location in multistory buildings, parking garages, and other related structures. If an emergency event occured in such a structure which required that aid be directed to the service subscriber's location, knowledge of the elevation component of location would be essential.

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[6] Teletrac's NPRM response, volume 1, page 24.

[7] Note that is assumed based on the chip rates that Teletrac discusses that Teletrac is referring to the null-to-null bandwidth of the main lobe of the wide band signal for its 8 MHz figure.

[8] See Teletrac NPRM response volume 1, page 7.

It not clear yet if smart antennas, in-building microcells, or some other approach will be required to resolve the elevation component of location, however, it is clear that simply having longitude and latitude information will not be sufficient.

State of MO, County of St. Louis
Signed before me on this 28th day
of July, 1993 by B. Keith Rainer
Notary Public Jessica L. Gamache

B. Keith Rainer
B. Keith Rainer

EXHIBIT 6

DECLARATION OF MICHAEL JOHN YERBURY

BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D. C. 20554

In the matter of	)	
	)	
Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems	)))))	PR Docket No. 93-61 RM-8013

TO: The Commision

Declaration of Michael John Yerbury

State of New South Wales,)
Australia.)

I, Michael John Yerbury, hereby declare as follows.

1. I am a consultant to British Aerospace Australia Limited (BAeA). My area of expertise includes spread-spectrum techniques, especially spread-spectrum location systems.

2. I have a bachelor's degree in electrical engineering from Loughborough University of Technology (UK) and a Ph.D. in physics from the University of Sydney, NSW, (Australia).

3. My professional experience includes employment as: an electronics engineer with Marconi's Wireless Telegraph Company Limited (UK); Research Associate for six years at the Center for Radiophysics and Space Research, Cornell University, NY, (USA); Senior Electronics Engineer with Advanced Technology Systems, NJ, (USA); Head of the Telemetry Group and Lecturer in the School of Physics, University of Sydney, NSW, (Australia) and Managing Director of Advanced Systems Research Pty. Limited, NSW, (Australia).

4. In 1979, while at the University of Sydney as Head of the Telemetry Group, I began to develop a spread-spectrum Automatic Vehicle Location (AVL) System designed to overcome the problems of multipath radio propagation encountered in typical urban and suburban areas. By 1981 my prototype system was operating in Sydney. In 1985 I resigned from the University of Sydney to co-found Advanced Systems Research Pty. Limited (ASR) principally to develop and commercialise spread-spectrum AVL technology. As Technical Director of the Company I was responsible for forming the R&D team and directing the *Quiktrak* development program. In 1986 I became Managing Director of the Company, a position I hold today. In October 1992, ASR's *Quiktrak* Technology was sold to BAeA.

5. I have authored and co-authored numerous engineering and scientific papers and reports and am a co-inventor on several patents including the primary *Quiktrak* patent. Over the past 15 years I have worked intensively in the field of spread-spectrum LMS systems and have gained considerable experience and knowledge of the performance of such systems in urban, suburban and rural areas. I am a Chartered Engineer and a Member of the Institution of Electrical Engineers (UK).

6. I have reviewed the comments of North American Teletrac and Location Technologies, Inc. as submitted to the Commision on 29 June 1993 and the statement attached as Exhibit A to

the Comments of Pinpoint Communications, Inc. I have participated in the preparation of the foregoing document entitled: "Remarks on Comments Made by North American Teletrac and Location Technologies, Inc. (Teletrac) and Pinpoint Communications, Inc. (Pinpoint) to FCC NPRM Docket 93-61" and declare that it is true and correct to the best of my knowledge, information and belief.

7. Also I have reviewed the accompanying Declarations of Joseph E. Fleagle and Gregory C. Hurst and concur with their conclusions.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on July 28th 1993.

Signed: ____________________

Michael John Yerbury

EXHIBIT 7

CORRESPONDENCE FROM ROTHMANS OF PALL MALL AUSTRALIA LIMITED

Rothmans of Pall Mall (Australia) Limited

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TELEPHONE: (02) 795 1111 FAX: (02) 795 1502

28 July, 1993

The Secretary,
Federal Communications Commission,
1919 M Street, N.W.
Room 222.

CERTIFICATE OF SERVICE

I, Ellen Dorsey, a secretary for the law firm of GURMAN, KURTIS, BLASK and FREEDMAN, CHARTERED, certify that copies of the foregoing "Reply Comments of Southwestern Bell Mobile Systems, Inc." were sent this 29th day of July 1993, by first class mail, postage prepaid, to the following:

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Ellen Dorsey
Ellen Dorsey

*By Hand